

REMARKS

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 1-11 are now pending in this application. In the specification, paragraphs have been amended on pages 22 and 23 to overcome the objections on page 4 of the Office Action. Claims 2 and 5 are currently being amended and new claim 11 has been added. Claim 11 recites that at least one of oxide particles and carbon particles are adhered only to a surface of the positive electrode active material body, as shown in Figure 3 and as described throughout the specification. No new matter was added.

I. Objection to the specification should be withdrawn

The specification was objected to. In response, pages 22 and 23 were amended to overcome the objection. Support for the amendment to the paragraph on page 22 can be found in Figure 1, for example.

II. The § 112 rejection should be withdrawn

Claim 5 was rejected under § 112, ¶ 2 as being indefinite. In response, claim 5 has been amended to affirmatively recite that carbon particles are attached to the surface of the positive electrode active material body to overcome the rejection. Likewise, claim 2 has been amended to affirmatively recite that oxide particles are attached to the surface of the positive electrode active material body.

III. The § 102(b) rejection should be withdrawn

Claims 1-8 are rejected under 35 USC § 102(b) as being anticipated by Suzuki (JP 6-236,756). This rejection is respectfully traversed.

Claim 1 of the present application recites that oxide and/or carbon particles are adhered to a surface of a positive electrode active material body. In contrast, Suzuki teaches that superfine oxide powder, such as Al₂O₃, is present in the polycrystalline particles of the positive electrode active material or in the grain boundary between the polycrystalline particles of the positive electrode active material body. The superfine oxide powder of Suzuki is not adhered to the surface of the positive electrode active material body, as recited in claim 1 of the present application. Thus, Suzuki does not anticipate claim 1 of the present application.

The term positive electrode active material body in claim 1 comprises a large particle of the composite oxide containing lithium, as shown in Figures 2 and 3 and as described on page 8, line 13, page 12, line 5 and page 20, line 3 of the present specification. As shown in Figures 2 and 3 of the present application, the positive electrode active material contains a plurality of these large particles or bodies of the composite oxide containing lithium. Preferably, these particles shown in Figures 2 and 3 comprise single crystal particles that have no grain boundaries inside the particles.

In contrast, the positive electrode active material body of Suzuki comprises an aggregate 9 of polycrystalline particles 3 separated by grain boundaries. The term “grain boundaries” in Suzuki indicates that each positive electrode active material body of Suzuki is an aggregate 9 of polycrystalline particles 3 separated by the grain boundaries and that each polycrystalline particle 3 of Suzuki is not in itself a positive electrode active material body.

Suzuki discloses an electrode material including an active lithium transition metal oxide and superfine particles 1 of a material such as Si₃N₄, SiC and Al₂O₃ in sizes below 3 microns, preferably between 0.2 to 0.5 microns. In the electrode for non-aqueous electrolytic battery of Suzuki, the superfine powder, such as Al₂O₃ (aluminum oxide) is present in the polycrystalline particles 3 or grain boundary between the polycrystalline particles 3 in the aggregate of the polycrystalline particles 9, or in both.

Thus, the superfine particles 1 of Suzuki are located inside the positive electrode active material body of Suzuki because these superfine particles 1 are located inside the aggregate 9 of the polycrystalline particles 3. The superfine particles 1 are located inside the particles 3 themselves or in the grain boundaries between particles 3 located on the inside of the aggregate body 9. In contrast, claim 1 of the present application recites that the oxide or carbon particles are adhered to the surface of the positive electrode active material body.

Paragraph 0015 of Suzuki also notes that as shown in FIG. 1 of Suzuki, the metal compound powder 9 consists of an aggregate of polycrystalline particles 3, and contains ultrafine powders 1. Furthermore, paragraph 0007 and other paragraphs of Suzuki clearly and repeatedly describe that the superfine powders exist in the inside of the particles of the polycrystalline substance particle of the metallic compounds, or the grain boundary or both. This is also shown in the drawings of Suzuki.

For example, Figure 1 of Suzuki shows that the superfine powders 1 are dispersed in the polycrystalline particles 3 constituting the aggregate metal compound powder 9. It is believed that Figure 2 shows that the superfine powders 2 may also be dispersed in the grain boundaries between the polycrystalline particles 3 constituting the aggregate metal compound powder 9.

Page 2 of the Office Action states that “The superfine particles may be deposited on the grain boundaries of the active material particles, and thus are adhered to the surfaces thereof (section 0006 and 0018).” (emphasis added) Applicants note that this is not sufficient to anticipate claim 1 of the present application.

The grain boundaries are located inside the electrode active material body 9 of Suzuki, as shown in Figures 1 and 2 of Suzuki. Thus, superfine particles located in the grain boundaries of Suzuki would be located inside the electrode active material body, but not on the surface of the electrode active material body, as recited in claim 1 of the present application.

Paragraph 0006 of Suzuki states that the superfine powders exist in the inside of the particle of the polycrystalline substance particle, or the grain boundary or both. Likewise,

paragraph 0018 of Suzuki states that it was confirmed that the superfine powder 1 of Si₃N₄ having a grain size of 0.5 microns existed within the polycrystalline substance particle 3 having a grain size of about 5 microns. Therefore, paragraphs 0006 and 0018 of Suzuki do not teach or suggest superfine oxide particles adhered on the surface of the active electrode material body, as recited in claim 1 of the present application.

IV. The § 103(a) rejection should be withdrawn

Claims 9 and 10 are rejected under § 103(a) as being unpatentable over Suzuki in view of Yomo (JP 4-162,357). This rejection is respectfully traversed.

A. Yomo does not remedy the deficiency of Suzuki

The secondary reference, Yomo, was relied upon for the teaching of the structure of the separator and housing for the cell. Thus, Yomo does not remedy the deficiency of Suzuki because Yomo does not suggest forming oxide or carbon particles on the surface of the electrode active material body of Suzuki.

B. Unexpected results

Furthermore, even if a prima facie case of obviousness is established, applicants respectfully rebut the prima facie case with evidence of unexpected results flowing from the claimed invention.

Page 17, second paragraph (lines 2-10) of the present specification describes an unexpected result provided by the positive electrode active material recited in independent claim 1. The at least one of the oxide particles and the carbon particles that are adhered onto the surface of the active material body greatly reduce the friction force among the active materials to thereby increase a flowability of the active material. Therefore, a positive electrode film having a higher density than that of a conventional positive electrode film can be obtained through a rolling operation under a high pressure. As a result, it becomes possible to realize a secondary battery excellent in charging/discharging characteristic and capacity. These results are summarized in Tables 1 and 2 on pages 25 and 32, respectively, of the present application.

As described in paragraphs 0014-0015 of Suzuki, the superfine powders 1 are dispersed in the polycrystalline particles 3 and/or the grain boundaries thereof so as to take a role as a cushioning member for mitigating the swelling and shrinkage of the polycrystalline substance particle when the battery is repeatedly charged and discharged. Therefore, the crystalline structure of the polycrystalline particles would not collapse, and the metallic compounds consisting of a number of the polycrystalline particles can be effectively prevented from being finely pulverized. This improves the life cycle of the battery.

Thus, Suzuki does not realize that at least one of oxide particles and carbon particles can be adhered to a surface of the positive electrode active material body for the purpose of greatly reducing the friction force among the active materials thereby to increase the flowability of the active material, as provided in the present specification. Suzuki also does not realize that a positive electrode film having a higher density than that of a conventional one can be obtained through a rolling operation under a high pressure. As a result, it becomes possible to realize a secondary battery excellent in charging/discharging characteristic and capacity.

When the oxide particles are dispersed in the grain boundary or inside of the polycrystalline substance particles, as described in Suzuki, these oxide particles do not reduce the friction force among the active materials and do not increase the flowability of the active material. In contrast, when the oxide particles are dispersed in the grain boundary or inside of the polycrystalline substance particles, as described in Suzuki, the polycrystalline substance particles do not exhibit a sufficient flowability, so that the electrode cannot be formed with a desirably high density even if the polycrystalline substance particles are pressed under a high pressure. Likewise, Yomo also does not disclose or suggest that the carbon particles or oxide particles can be used as a material for greatly reducing the friction force among the active materials thereby to increase a flowability of the active material.

Thus, the references applied in the Office Action neither disclose nor suggest that the carbon particles or oxide particles adhered to the surface of the positive electrode active material body can be used as a material for greatly reducing the friction force among the active materials thereby to increase the flowability of the active material. This provides an

unexpected result where a positive electrode film having a higher density than that of the conventional one can be obtained through a rolling operation under a high pressure, and it becomes possible to realize a secondary battery excellent in charging/discharging characteristic and capacity.

Furthermore, the superfine particle 1 materials of Suzuki, such as SiC, Si₃N₄, and Al₂O₃, have a high electric resistance and do not participate in the battery reaction. Since these superfine particles 1 are contained within the active material particles, the battery characteristic is disadvantageously lowered. Furthermore, the active material body aggregate 9 of Suzuki has a polycrystalline structure and is liable to be collapsed from the grain boundaries as a starting point, thereby lowering the battery capacity.

In contrast, the active material body of the preferred embodiment of the present invention has a single crystal structure that lacks grain boundaries. Such a structure is less likely to be collapsed, so that when the active material body particles are used in the battery electrode material, a battery capacity would not lowered.

Furthermore, the electric current is not easily transmitted to the polycrystalline particles located within the active material body of Suzuki, so that the polycrystalline particles located within the active material body particles are not completely utilized to promote the battery reaction. As a result, the capacity of the battery becomes poor.

In contrast, when the single crystal active material bodies of the preferred embodiment of the present invention are used as the battery electrode material, the whole single crystal body can contact the conductive agent contained in the positive electrode layer. Therefore, an electric current can be easily collected from all the active material bodies.

V. Conclusion

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The

Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date 12/22/03

By Leo Radomsky

FOLEY & LARDNER
Customer Number: 22428
Telephone: (202) 672-5300
Facsimile: (202) 672-5399

Leon Radomsky
Attorney for Applicant
Registration No. 43,445

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.